Citation:

Dixon LB, Pellizzon MA, Jawad AF, Tershakovec AM. Calcium and dairy intake and measures of obesity in hyper- and normocholesterolemic children. Obes Res. 2005 Oct;13(10):1727-38

PubMed ID: 16286520

Study Design:

Prospective cohort study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To examine whether intake of calcium and dairy foods was associated with body mass index (BMI) and skinfold measures in hypercholesterolemic (HC) and normocholesterolemic (non-HC) children, ages 4 to 10 years, at baseline and over the course of one year.

Inclusion Criteria:

- 4 to 10 year children
- non-fasting plasma total cholesterol above 4.55 mM (176 mg/dL, 75th percentile)
- free of secondary causes of hypercholesterolemia
- at least 85% but not > 130% of ideal body weight at baseline

Exclusion Criteria:

- none specified

Description of Study Protocol:

Recruitment:

- Data from the Children's Health Study analyzed. Children were identified between October 1990 and December 1992 through a cholesterol screening program implemented in pediatric practices in the northern suburbs of Philadelphia.
- Those with non-fasting plasma total cholesterol above 4.55 mM (176 mg/dL, 75th percentile), were invited to provide two fasting venous blood samples within two weeks of each other.

Design: trend study

Blinding used (if applicable): N/A

Intervention (if applicable): N/A

Statistical Analysis

- descriptive statistics for the 1 year study period
- log transformation of sum of skinfolds and trunk skinfolds
- Student's t-test to compared HC and non-HC children at each time period
- Pearson correlations to assess bivariate relations between children's dietary intakes and the measures of obesity at baseline
- multivariate linear regression models created with each obesity measure (BMI, BMI z-score, sum of skinfolds, trunk skinfolds) as DV, and baseline intake of calcium or dairy foods as primary IV, and children's age, sex, cholesterol risk status, and baseline intake of energy and percentage energy from fat as covariates;
    - interaction term between cholesterol risk status and intake of calcium or dairy foods included
    - because it was significant, separate models were run for HC and non-HC children
- additional models run for 4-6 and 7-10 year olds
- separate random effects mixed regression models to evaluate whether intake of calcium over the 1-year period was associated with the obesity measures for HC and non-HC children with each obesity measure as the DV and calcium intake (continuous) as primary IV, with covariates included
- sensitivity analyses conducted to confirm findings

Data Collection Summary:

Timing of Measurements

- baseline, 3, 6, and 12 months

Dependent Variables

- body mass index (BMI): calculated from measured height and weight
- BMI z-score
- adiposity: sum of skinfolds (biceps, triceps, suprailiac, and subscapular)
- truncal adiposity: trunk skinfolds (suprailiac and subscapular skinfolds)

Independent Variables

- calcium intake: estimated for 3-day 24-hr hour recalls (2 weekdays and 1 weekend day, randomly chosen) (Nutrition Data System (NDS)
    - parent of 4 to 7 year olds was interviewed with children available for questions
    - 8 to 10 years olds were themselves interviewed with a parent available for questions
- dairy food intake: determined from food codes generated by NDS

Control Variables

- age
- sex
- baseline intake of energy

- baseline percentage of energy from fat
- cholesterol risk status (with or without hypercholesterolemia):
    - hypercholesterolmic (HC): LDL-C between 80th and 98th percentiles: [2.77 to 4.24 mM (107 to 164 mg/dL) for boys and 2.90 to 4.24 mM (112 to 164 mg/dL for girls]
    - normocholesterolemic (non-HC): children with total cholesterol less than the 60th percentile [4.21 mM (163 mg/dL) for boys and 4.37 mM (168 mg.dL) for girls] were randomly selected

Description of Actual Data Sample:

Initial N: N=342 (HC = 261; non-HC = 81); males=171; females=171

Attrition (final N): N=342

Age: baseline mean

- HC group: 6.4 years
- non-HC group: 6.6 years

Ethnicity: predominantly white (specific data not given)

Other relevant demographics:middle to upper socioeconomic status (data not given)

Anthropometrics :

Baseline anthropometric characteristics in HC and non-HC children

	HC	non-HC
N	261	81
Height (cm)	117.2	119.2
Weight (kg)	22.9	23.2
BMI (kg/m^2)	16.3	16.0
BMI z-score	0.19	0.09
Sum of skinfolds (mm)	28.0	25.6
1n (Sum of skinfolds (mm)	3.28[a]	3.19[a]
Trunk skinfolds (mm)	12.8	11.4
ln (Trunk skinfolds) (mm)	2.48[a]	2.37[a]

[a] $p < 0.05$

Location: United States (Philadelphia, PA)

Summary of Results:

Key Findings

- Children's calcium (HC=761 mg, non-HC=865 mg, P<0.05) and dairy intakes (HC=2.7 servings/day; non-HC=3.2 servings/day, P<0.05) at baseline were strongly correlated (r=0.85, P<0.0001)
- At baseline, children's dairy and energy intakes, but not calcium intakes, were correlated with BMI (r=0.14, P=0.008 and r=0.20, P=0.0002) and BMI z-score (r = 0.11, P=004 and r=0.17, P=0.002).
- In all children, baseline intake of calcium or dairy foods and their age, sex, cholesterol risk status, and baseline intake of energy and fat explained more than 20% of the variation in all measures of obesity, except BMI z-score.
    - The interaction term between the children's cholesterol risk status and their intake of calcium or dairy foods showed an inverse relation between intake of both calcium and dairy foods with BMI, sum of skinfolds, and trunk skinfolds that differed between HC and non-HC children at baseline.
- In models for HC children only:
    - baseline calcium intake was not associated with any obesity measure after adjusting for age, sex, and baseline intake of energy and percentage energy from fat.
    - baseline dairy intake was not associated with BMI or trunk skinfolds, after adjusting for covariates
    - In all age groups of HC children, calcium intake over 1 year period was not associated with any measure of obesity, after adjusting for covariates
- In models for non-HC children only:
    - in models for non-HC children 4 to 10 years of age, baseline calcium intake was inversely associated with sum of skinfolds (P=0.05) and trunk skinfolds (P=0.04.
    - In 7 to 10 year old non-HC children, baseline calcium intake was also inversely associated with BMI (P-0.03) as well as sum of skinfolds (P=0.02) and trunk skinfolds (P=0.02).
    - sum of skinfolds and trunk skinfolds decreased in the lowest and highest quartiles of calcium (<757 and >1222 mg/day) for the 7 to 10 year non-HC children (P<0.05)
    - skinfold measures tended to decrease with increasing dairy intake in both age groups; trunk skinfolds differed significantly (P<0.05) between the two lowest quartiles of dairy intake (<2.4 svg/day and 2.4 to 3.3 svg/day)
    - In 4 to 10 year old non-HC children, calcium intake over 1 year was inversely associated with sum of skinfolds (P=0.03) and trunk skinfolds (P=0.03).
    - In 7 to 10 year old non-HC children, calcium intake over 1 year was inversely associated with BMI P=0.05) and trunk skinfolds (P=0.04).

Obesity and dietary measures in HC and non-HC children, 4 to 10 years old, over 1 year

	Baseline		3 months		6 months		12 months	
	HC	non-HC	HC	non-HC	HC	non-HC	HC	non-HC
N	261	81	227	76	216	75	219	75

Age (years)	6.4	6.6	6.7	6.9	7.0	7.2	7.5	7.7
Height (cm)	117.2	119.2	119.1	121.6	121.1	123.4	124.0	126.5
Weight (kg)	22.9	23.2	23.8	24.4	24.6	25.2	26.2	26.8
BMI (kg/m^2)	16.3	16.0	16.7	16.6	16.4	16.3	16.6	16.4
BMI z-score	0.19	0.09	0.34	0.33	0.16	0.14	0.19	0.13
Sum of skinfolds (mm)	28.0	25.6	30.4^b	28.2^b	28.7	26.2	29.5	26.6
1n (Sum of skinfolds)(mm)	3.28^a	3.19^a	3.30^b	3.21^b	3.30^c	3.21^c	3.32^d	3.23^d
Trunk skinfolds (mm)	12.8	11.4	13.4^b	11.6^b	13.5^c	11.8 ^{c}	13.9^d	12.1^d
1n (Trunk skinfolds) (mm)	2.48^a	2.37^a	2.51b	2.39 b	2.52^c	2.41^c	2.54^d	2.44^d
Calcium (mg/d)	761^a	865 ^{a}	758^b	900b	768 ^{c}	887 ^{c}	822 ^{c}	943 ^{c}
Dairy foods (svg/d)	2.7	3.2	2.8	3.2	----	----	----	----
Energy (kcal/d)	1599^a	1723 ^{a}	1581^b	1774^b	1594^c	1777^c	1667^d	1792^d
Energy from fat (%)	29.4	29.9	28.5	29.4	28.4^c	30.2 ^{c}	28.4	29.4
Energy from protein (%)	14.0	14.3	14.2	13.9	14.1	13.7	14.3	14.3

1n, log transformation of the sum of skinfolds and the trunk skinfolds

* Variables with the same superscript differed significantly (P<0.05) betwee HC and non-HC children at the respective time period.

--- servings of dairy foods were not available at 6 or at 12 months

Correlations between energy/macronutrient intake and calcium/dairy

	Calcium	Dairy
Energy	0.59*	0.49*
Protein	0.52*	0.48*
Fat	0.65*	0.48*

* All P<0.0001

Other Findings

In models for HC children only:

- in 7 to 10 year old children, BMI, sum of skinfolds, and trunk skinfolds tended to decrease with increasing calcium intake across the first three quartiles of intake
- dairy intake was positively associated with sum of skinfolds in 4 to 10 year olds, but did not reach statistical significance for the 4 to 6 or the 7 to 10 year old children
- in the 7-10 year old children, BMI and skinfold measures tended to be similar across the first three quartiles of dairy intake, but consistenly higher in the highest quartile of daiary intake (>3.8 servings/day) (NS)

In models for non-HC children only:

- baseline dairy intake was not associated with any measure of obesity, but all β-coefficients

were negative, suggesting an inverse relationship

Author Conclusion:

Results suggest a complex relation among intake of calcium and dairy foods, measures of obesity, age, and serum cholesterol in children. Older children without risk of metabloic syndrome may benefit most from increased calcium intake.

Reviewer Comments:

the multiple-pass 24-hour recall used by NDS is a valid and reliable method for assessing dietary intake, although not without potential self-report bias

sample included primarily white, middle and upper middle class children; results may not be generalizable to other groups

participants were in a nutrition education study - it is unclear what the nutrition education included and if this may have influenced intake or had an impact on body composition; presumably this would have been mentioned?

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes

2.	**Was the selection of study subjects/patients free from bias?**	No
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	No
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	N/A
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	N/A
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes

5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	Yes
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	N/A
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	Yes
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes

	7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**		Yes
	8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
	8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
	8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
	8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	Yes
	8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
	8.6.	Was clinical significance as well as statistical significance reported?	Yes
	8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**		Yes
	9.1.	Is there a discussion of findings?	Yes
	9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**		Yes
	10.1.	Were sources of funding and investigators' affiliations described?	Yes
	10.2.	Was the study free from apparent conflict of interest?	N/A